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MANAGEMENT OF INSECT PEST BY COMBINING FERTILIZER, MANURES, PLANT PRODUCT AND NATURAL ENEMIES: A REVIEW

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Abstract
Increasing use of pesticide concentration in soil leads the biomagnifications of harm full chemical in soil and plant day to day is a persistent problem .The worldwide ecology facing challenge to survive in its original form. The green revolution increases the food production manifold by combining the variety, fertilizer, technology etc. The aim of increasing production of the farm produce diverted the farmer to apply overdose of fertilizer also. The presenting era of pest management now a day shifted to NPM instead of IPM. The need of present food production maximize per unit so the present reviews focused on management of insect pest with the use of organic manure and inorganic fertilizer .The biologically importance insects are also beneficial for us so the present study also focused on these. The plant product also plays a great role in pest management. The plant nutrient affects insect physiology directly.

Key Words: Fertilizer, Manure, Natural Enemies, Physiology.

The pant body constituted by around hundreds of elements. The all elements have their different role in plants. The essential elements for plant are 17 and different ecological zone having variable capacity to supply the nutrient. The intensive cultivation of crop leads to element exhaustation from the soil for the maintaining the production we apply manure and fertilizer .The N P K majorly feed by plants and thus need to supply .The Farmer need to apply NPK in 4:2:1 ratio for supply and maintaining the output. During the last decade extensive use of pesticide and nitrogenous fertilizer leads to insect pest problem. The modern era cannot refuse the use of fertilizer but the appropriate use of this fertilizer is necessary with maximize the organic manures? If we apply optimum dose of fertilizer, organic manure and biological agent for the management of insect pest then sustainable agriculture leads day to day.

Importance of Fertilizer and Manure In Pest Management

Nitrogen in the soil is absorbed by the plant in the form of nitrate and ammonium ions, it is used by plants to synthesize amino acids, proteins and other complex nitrogenous compounds like chlorophyll. Adequate supply of nitrogen is associated with high photosynthetic activity, vigorous vegetative growth and a dark green colour of the leaves (John et al., 2004). Phosphates help in the formation of nucleic acids and high energy phosphate compounds like ATP (Syers et al., 1986). Poultry manure has historically been used as a source of plant nutrients and a soil amendment to enhance soil productivity, increase the soil organic carbon content, micro-organisms, crumb structure, nutrient status of the soil and crop yield (Beckman,1973). Poultry manure has nitrogen as its major component but contain many other nutrients such as potassium, phosphorus, magnesium, sodium and calcium that are essential for plant growth. Chemical fertilizers are compounds given to plants to promote growth, and are usually applied either through the soil for uptake by plants, or by foliar feeding, for uptake through leaves. One of the ways of increasing the nutrient status is by boosting the soil nutrient content either using organic materials such as poultry manure, animal waste, compost or inorganic fertilizers (Dauda et al., 2005). Fertilizers in general are one of the major inputs for increased agricultural productivity. The form of these inputs can influence pest populations in various agro ecosystems, depending on the kind of fertilizers used, the crops grown, and the insect pests present. However, excessive nutrient application can also lead to pest problems by increasing the reproduction, longevity and overall fitness of certain pests (Jahn, 2004). Reduction in aphid population due to the application of organic manure in brinjal crop has been reported in India (Godase & Patel, 2001). Sureka & Rao (2001) indicated that application of vermicompost at 7.5t/ha was more effective in bringing down aphid population on okra. Yardim and Edwards (2003) when they evaluated the effects of organic and synthetic fertilizer sources on pest and predatory

insects associated with tomatoes. Miguel and Clara (2003) observed that crops grown with organic matter generally exhibit less insect herbivores, reductions that may be attributed to a lower nitrogen content in organically farmed crops. Yadav et al. (2004) working on Okra plants grown with poultry manure observed increased plant height with relatively fewer pest attacks.

El- Nabawy et al (2016) experimented with Solanum melongena field with two different treatment which is organic fertilizer and chemical fertilizer in two year and in last year surrounding organic fertilizer plots with the flowering plots mealy cup sage (Salvia farinacea Benth), spearmint (Mentha spicata L) and basil (Ocimum basilicum).The number of collembola,thrips,lycosid and linyphid spider were higher in organic fertilizer with flowering plants treatment compare to chemical fertilizer.The number of Henosepilachna vigintioctopunctata were significantly lower in organic fertilizer with flowering plants treatment than in chemical treatment.

Brotodjojo and Arbiwati Treatment used is kind of organic fertilizer granules (A, B, C) of own products applied with various doses (10 tons/ha, 20 tons/ha, 30 tons/ha). For comparison is a control that uses inorganic fertilizers (Urea 60 kg/ha; TSP 95 kg/ha; KCl 50 kg/ha). Plant tested were caysim against Crocidolomiapavonana larvae and Aphids sp. as well as potato against Lepidiota stigma larvae. The use of fertilizers 10-30 tons/ha can be slightly depressed L. stigma feeding. Lepidiota stigma larvae on unfertilized soil consumed more potato tuber than that of the fertilized soil. Caysim treated with inorganic fertilizers suffered more damaged caused by C. pavonana that that treated with granular organic fertilizer. Population of Aphids sp. on Caysim treated with inorganic fertilizers were higher than that that treated with granular organic fertilizer. Organic fertilizer can increase plant resistance against pest.

Conventional intensive cultivation put more emphasis on the use of inorganic fertilizers as a source of plant nutrients and synthetic pesticides to suppress pests attack. However, the use of inorganic fertilizers, especially nitrogen fertilizers, continuously in the long term without a balanced use of organic materials can have a negative impact on the physical and chemical properties of the soil. Decline in soil physical properties is indicated by soil compaction and porosity reduction. Decline in soil chemical properties is shown by reduced soil fertility and content of essential micro nutrients in the soil, which in turn will lower crop yields (Zhang et al 2008).

To overcome the adverse effects of conventional farming on the environment and health, the then switch back to organic farming. Organic farming is a cultivation technique by utilizing organic fertilizer as a source of plant nutrients and avoiding the use of inorganic fertilizers and synthetic chemicals for pest control. Proper fertilization may accelerate and strengthen the growth and development of plants, add resistance to certain pests and diseases, as well as improve the quality and quantity of agricultural product. The positive impact of organic fertilizer seen in the short term and long term, which increase soil fertility and crop yields (Granstedt, & Kjellenberg 1997, Lazcano et al 2013).

Boiler ash provide a positive influence for the plant through two things: the indirect influence on the soil by improving the availability of P and a direct influence on the plant, such as improving the efficiency of photosynthesis, induces resistance to biotic and abiotic stresses such as pests and diseases, poisoning Fe, Al, and Mn, reducing the collapse and fix erectness (erectness) leaves and stems, as well as improve the efficiency of water use. Improved crop yields are mostly due to the increase in the quantity and quality of results. This indicates that Si improve the efficiency of plant photosynthesis. Giving Si (silicates) causes the leaves to grow stronger and can stretch well, so that it can reduce the negative impact of mutual shading. Silicate that there will improve plant resistance to pests and diseases (Savant et al. 1999).

Atijegbe et al. (2013) reported that higher numbers for all major insect pests were recorded on NPK-treated plots. Fewer insect pests were recorded on Poultry Manure amended plots for all the major insect pests. The lower insect pest numbers on plants grown on organic manure is attributed to some extent to slower release of nutrients to plants and balanced nutrient level through PM. High insect numbers on plants fertilized with NPK could be attributed to inorganic N fertilization, resulting in fast rate of release of nitrogen creating an imbalance which

decreases the plant's ability to resist insect pest infestation and attack. A. binubila larvae, a Coleopteran, of the family Cerambycidae caused 100% damage of all plants at 9 weeks after planting (WAP), boring the vines and causing wilting and death of the plants which resulted in no yield. Wilting of the plants was first noticed at 7 weeks after planting (WAP). The ability of the plants becoming susceptible to the attack by A. binubila could be as a result of a high N and low K content in the soil, since fertilizing crops with N and insufficient K makes crops more susceptible to insect pests. It has been shown that adding various organic composts to soil can suppress pest populations and damage to plants growing in amended soils (Alteri and Nicholls, 2003; Atkinson et al., 2004). Just as fertilizer produces a more nutritious plant for man, so many insects may also benefit. Aphids, leafhoppers, mites, leaf rollers, thrips and the leaf mining grubs, etc. have been found to breed and develop more rapidly on plants given good fertilization (Van Emden 1980). Excess nitrogen supply conditions make soybeans susceptible to pest attack, especially the stem and foliar pests(Tisdale and Nelson 1975). On the other hand, adequate supply of K to crops increases their ability to resist pest and disease attack, thereby ensuring good quality produce. Plant health can be measured by its susceptibility to or tolerance of depredation by pests.

Atijegbe 2014 reported the effects of NPK 15: 15: 15 and poultry manure on the yield of okra and incidence of insect pests on the crop. Application of poultry manure (PM) at the rate of 10tha-1 had the highest yield and reduced number of insect pests, although mean plant height and mean leaf number were highest with 500kgha-1 NPK treatment at 10 WAP, mean leaf number followed a similar pattern. Stem girth was highest in 10tha-1 poultry manure and was not significantly different from 500kgha-1 NPK treatment. Complementary application of 10tha-1 poultry manure and 300kgha-1 NPK favoured okra growth and yield most in terms of quantity and quality (market value) and decreased insect pest infestations. Poultry manure at 10tha-1 turned out to be the most beneficial application compared with the other treatments. The use of organic amendments applied to soil not only enhances its nutrient status but also reduces the incidence of pest (Adilakshmi et al., 2007).With the increase application of NPK, there was a corresponding increase in insect pest infestation across insect species, while the reverse is the case with PM (Zehnder et al., 2007). Stone et al. (2000) who reported that increasing soluble nitrogen levels in plants from organic manures sources can decrease their resistance to insect pest.

Population outbreaks of M. persicae are somehow suppressed by synthetic insecticides but strong selection pressure of chemical spraying induces resistance to the most registered insecticides so other control methods need to be investigated for appropriate control (Bolandandam et al., 2004). Fertilizers are recommended to increase crop yields but they can affect pest populations leading to to use control procedures (Patriquin et al., 1995; Arancon et al., 2006; Edwards et al., 2009).Fertilizers residue have raised a great concern of consumers in recent years because of their chemical constituent. So, organic fertilizers may be more appropriate because of their least effects on environment or residual contaminations. Vermicompost is an organic fertilizer produced through the interactions between earthworms and microorganisms in a mesophilic process from organic wastes. It reduces pH and C:N ratio in soil, stabilizes the organic matter and makes nutrients readily available to plants (Yardim et al., 2006). Soil amendment with vermicompost have reduced population growth rates in some herbivores such as Manduca quinquemaculata, Acalymma vittatum, Diabrotrica undecimpunctata (Yardim et al., 2006), Leptinotarsa decemlineata (Mardani-Talaee et al., 2015), Pseudococcus sp., Teranychus urticae, M. persicae (Arancon et al., 2002, 2006; Edwards et al., 2009; Mardani-Talaee et al., 2016), and Aphis gossypii (Razmjou et al., 2011).

Asawalam et al. (2007) reported the influence of some soil amendments on insect pest infestation of Okra. High nitrogen promoted the vegetative growth of the plant, also pest found the leaves of these plants succulent and fresh, this made these plots prone to high pest infestation.Proponents of organic farming have long promoted the view that the likelihood of pest outbreaks is reduced with organic farming practices, including establishment and maintenance of "healthy" soil (Howard, 1940; Oelhaf, 1978; Merrill, 1983). Recent studies have shown that plant resistance to insect and disease pests is linked to optimal physical, chemical, and—perhaps most importantly—biological properties of soil (Altieri and Nicholls, 2003; Zehnder et al., 2007).The few conducted studies suggest that lower pest pressure in organic systems could result from the greater use of crop rotation and/or preservation of beneficial insects in the absence of pesticides (Lampkin, 1990). Alternatively, reduced susceptibility to pests may be a reflection of differences in plant health, as mediated by soil fertility management (Phelan et al., 1995). In

Japan, density of immigrants' of the planthopper species Sogatella furcifera was significantly lower and the settling rate of female adults and survival rate of immature stages of ensuing generations were generally lower in organic compared to conventional rice fields. Consequently, the density of planthopper nymphs and adults in the ensuing generations was found to decrease in organically farmed fields (Kajimura, 1995). The effects of food waste vermicompost on populations of adult striped cucumber beetles (Acalymma vittatum) and spotted cucumber beetles (Diabotrica undecimpunctata) on cucumbers and larval hornworms on tomatoes (Manduca quinquemaculata) were evaluated in both greenhouse and field experiments as well as damage caused. In the field, cucumber and tomato plants were grown, with two different application rates (1.25 and 2.5 t ha_1) of food waste vermicompost or inorganic fertilizer, in a complete randomized block design field experiment. All treatments were balanced for NPK. Field cucumber beetle populations were suppressed significantly on cucumber plants treated with food waste vermicompost at both application rates, compared with those on plants treated only with inorganic fertilizer. In the greenhouse, cucumber and tomato plants were grown in a soil-less medium MetroMix 360 (MM360) substituted with 0%, 20% or 40% food waste vermicompost, and exposed to standardized pest attacks in nylon mesh cages. In the greenhouse, both the 20% and 40% vermicompost substitution rates decreased damage by cucumber beetles to cucumber foliage and hornworms to tomato foliage significantly.(Erdal et al 2006). It has been shown that various organic amendments, including manures and composts to soil, can suppress pest incidence, populations and damage to plants growing in the amended soils (Chellemi, 2002; Altieri and Nicholls, 2003; Atkinson et al., 2004). The first reports of vermicomposts suppressing arthropod pests were by Edwards and Arancon (2004) and Arancon et al. (2005b) who showed that vermicomposts suppressed cabbage white caterpillar attacks on cabbages. Theses authors also reported significant suppression of mealy bug attacks (Pseudococcus) on cucumbers and tomatoes, two-spotted spider mite attacks (Tetranychus urticae) on bush beans and eggplants and attacks by aphids (Myzuz persicae) on cabbages by lowapplication rates of food waste vermicomposts (Arancon et al., 2005a, b).The experiments reported here aimed to evaluate the effects of low application rates of food waste vermicomposts in the field, or substitutions of vermicomposts into soil-less bedding plant growth medium (MM360) in the greenhouse, on cucumber beetle and hornworm populations. They will also document resulting damage to cucumber and tomato plants, compared with populations of these pests and damage to plants grown with only inorganic fertilizers, in the greenhouse and field, when all of the nutrient inputs were balanced for NP and K. Organic rice was reported to have thicker cell wall, more tolerance and even more resistance to insect attacks than conventional rice (Ramesh et al. 2005).Application of organic fertilizer for two consecutive years in maize field was recorded to host fewer populations of aphid (Rhopalosiphum maidis) than maize grown with synthetic fertilizers(Morales et al. 2006). Surekha and Rao (2001) and Prakash et al. (2002) explored the utility of organic manures for managing the pests of okra. The effect of organic amendments in suppressing the sucking pests of okra by the report of Surekha and Rao (2001) who showed that the application of vermicompost @ 7.5 t/ha was significantly more effective in bringing down the aphid population in okra.Reduction of aphids due to the application of organic manures in brinjal crop have been reported in past (Godase and Patel, 2001 and Kavitharaghavan et al. 2005). Prakash et al. (2002) who showed lower percentage of fruit borer infestation in okra when the plants were treated with FYM and vermicompost.

Population of thrips in Jasminum sambac (Mysore mallige) ranged from 2.00 to 5.00 thrips /flower. Significantly less thrips population of 2.00 per flower was recorded in the treatment 2.0 t vermicompost / ha at the time of pruning + vermiwash application 1:3 (1, 4,7,10 weeks after pruning). Bud borer population in J. sambac (Mangalore mallige) varied from 6.33 to 14.67 damaged flowers / plant. Damaged flowers in J. sambac (Mysore mallige) were less compared to J. sambac (Mangalore mallige).(MEENATCHI et al. 2011). Vermitechnologies when used in crops are known to induce resistance in plants against pest debilitations (Saumya et al., 2007; Manu, 2005). Role of vermicompost in the management of sucking pests on different crops has been reported by different authors Smitha (2002), Giraddi et al., (2003) Saumya (2006) and Gundanavar (2006) in chilli v/s thrips and mites and Balasubramanium and Muralibhaskaran (2000) Manu (2005) in cotton for managing sucking pests.

Biological Control of Insect Pest

True spiders are effective natural predators in field crops, but their effects depend on their densities in agro ecosystems (Riechert and Lawrence 1997,Marc et al. 1999, Landis et al. 2000,Symondson et al. 2002,Schmidt et al. 2003).They kill and consume a large number of prey daily (Riechert and Lawrence 1997, Riechert and Maupin 1998).Hunting spiders decreased numbers of herbivorus Coleoptera in an old field in Tennessee (Riechert and Lawrence 1997).

The quality of organic materials and the plant structure are very important to increase the soil organism densities (Yeates et al. 1997). Besides, the diet for most Collembola species is soil fungus or decaying material of plant (Verma and Paliwal 2010). Manure application improves soil quality and structure, and it enhanced the population of saprophagous insects such as springtails (Collembola) and midges (Diptera). These prey are very important for the survival of their predators (Alderweireldt 1994, Chen and Wise 1999, Nyffeler 1999, Axelsen and Kristensen 2000. Hendawy and Abul-Fadl (2004) have reported greater densities of lycosid and linyphiid spiders in organic fertilization fields than in chemical fertilization fields. Birkhofer et al. (2008) indicated that organic fertilizer had a positive effect on the ground-dwelling spiders. Additionally, numbersof sheet-web weavers spiders (Linyphidae) had a positive respond to Collembola (Birkhofer 2007). The organic fertilizers treatment supported species richness of weeds, numbers of earthworm, and density and diversity of some invertebrates higher than mineral fertilizers treatment (Dicks et al. 2013). O berg (2007) reported that the densities of lycosid and linyphiid spiders increased in response to organic treatment. Lycosid and linyphiid (Araneae) spiders are commonly found in arable land in central and northwestern Europe (Toft 1989, Feber et al. 1998, Samu and Szinet_ar 2002, Pfiffner and Luka 2003, Clough et al. 2005,O¨ berg and Ekbom 2006), and play an essential role in suppressing aphid populations (Luczak 1979, Nyffeler and Benz 1987, Mansour and Heimbach 1993, Lang 2003, O¨ berg and Ekbom 2006). Proper habitat management can enhance the populations of natural enemies for biological control in agricultural ecosystems (Alomar et al. 2006, Bianchi et al. 2006). Providing good refuges can enhance the density of spiders (Sunderland and Samu 2000). Spider population increased and aphid population decreased when the wheat field contained strips of flowering plants (Jmhasly and Nentwig 1995). Flowering plants strips play an essential role in biological control by enhancing the predators and the alternative prey densities (Frank 2003). Lycosid spiders can feed on thrips (Sahito et al. 2013).Thysanoptera were captured at the web of linyphiid spiders and they expected that it was a suitable prey for spiders (Harwood et al. 2003). Marc et al. (1999) indicated that it is necessary to manage the environment (i.e., habitat quality) to enhance the communities of true spiders. Spider communities are very sensitive to sources of environmental change, such as soil pollutants and chemical pesticides. Diverse habitats provide an abundance of various food sources and thus can increase the populations of natural enemies (Hatley and Macmahon 1980, Landis et al. 2000, Jonsson et al. 2008). Flowering plants such as mealy cup sage (Salvia farinacea) can play an essential role in enhancing the natural enemies of crab spiders, predatory bugs, and chalcidoid wasps (El-Nabawy et al. 2015). Peterson et al. (2010) and Carrel et al. (2000) reported that Linyphiidae also feeds on pollen. Pollen as a food source for natural enemies (Bernardello et al. 2000, Landis et al. 2000, Jackson et al. 2001, Fiedler and Landis 2007, Lundgren 2009, Peterson et al. 2010, Messelink et al. 2014). Pollen is an excellent food source also for spiders, particularly for spiderlings, when prey populations are insufficient. Pollen increases the longevity of spiderlings (Vogelei and Greissl 1989).

Importance of Plant Product In Pest Management

Neem is one of the plants that can be used as a pesticide plant. Neem contains azadirachtin, an active ingredient that is toxic against insects. The active ingredient in the seeds is higher than in the leaves (Schmutterer 1990). Extracts of neem seed hinder eating and cause death of Plutellaxylostella L. caterpillars 72 hours after application (Brotodjojo 2014). Previous study indicated that neem seeds extract application and neem leaves used as mulch were effective for controlling Cylasformicarius (Fabricius) on sweet potato (Supriyatin 2000). Azadirachtin and neem oil increased mortality of Aphis glycines Matsumura nymphs and prolonged the developmental of surviving insects (Kraiss & Cullen 2008). Neem can also function as a natural soil conditioner that helps improve the quality of soil, but also prevents plants from being attacked by certain insect pests (Lokanadhan 2012). Neem leaves

powder was proved to have insecticidal properties on various insects, including Macrotermes spp., Phaseouslus spp., Periplaneta spp. and larvae of Anopheles spp (Achio 2012).

In sugarcane content of crystalline Si in leaf and stem epidermis tissue will increase plant resistance to borer attack. The mouthpart of young larvae will be damaged if they consume plant containing crystalline Si(Anonymous 2006) Other study has shown that the high silica content in rice leaf epidermal tissue is very effective to increase resistance to insect pests(Sumida 2002). Previous study showed that infestation of aphids (Rhopalosiphummaidis) on corn in fields treated with organic fertilizer for at least 2 years was lower than corn treated with synthetic fertilizer(Morales et al. 2001). It is suggested that nitrogen stimulates insect reproduction. Other study showed that fecundity and developmental rates of the green peach aphid, Myzuspersicae increased as levels of soluble N in leaf tissue increased (Emden 1966).

Effect of Nutrient on Insect Physiology

M Mardani-Talaee et al (2016) reported zinc sulfate and vermicompost as chemical and organic fertilizers, were added into cultural soil of Capsicum annuum to determine their effects on physiology and antioxidant activities of M. persicae. The aphids reared on zinc sulfate-treated culture showed the highest activities of general protease, trypsin, cathepsins, carboxypeptidase and lipase but activities of chymotrypsin and aminopeptidase were the highest in vermicompost-treated culture. Although activities of α-amylase in the fertilizer-treated cultures were higher than control but activities of α- and β-glucosideases showed the highest values in zinc sulfate and vermicompost treatments, respectively. Aspartate aminotransferase and γ-glutamyl transferase showed the highest activity in the aphids reared on the vermicompost-treated culture but alanine aminotransferase activity got the lowest value in fertilizer-treated cultures. Activities of aldolase and lactate dehydrogenase in the fertilizer-treated aphids were higher than those of control and vermicompost-treated aphids, but alkaline phosphatase showed the lower activity although activity of acid phosphatase decreased in vermicompost- treated aphids compared to other treatments. Activities of antioxidant enzymes were found to be the highest in the aphids fed on vermicompost-treated culture including glucose-6-phosphate dehydrogenase, superoxide dismutase, peroxidase and ascorbate oxidase but catalase in vermicompost treatment had lower activity than control and zinc-sulfate treatments. Also, malondialdehyde and RSSR/RSH ratio demonstrated higher values in the aphids fed on zinc sulfate- and vermicompost-treated plants than control, respectively. Finally, the amounts of glycogen and triglyceride revealed the highest values in zinc sulfate-treated plants compared to other treatments. These results indicated significant effects of fertilizers on physiology and antioxidant activity of M. persicae which are important to be considered in integrated pest management programs. Fertilizers can fluctuate amounts of defensive chemical components in plants which finally change ecological fitness and physiological performance of herbivorous insects (Edwards et al., 2009; Mardani-Talaee et al., 2016). Numerous studies have reported the effects of macronutrient chemical fertilizers (such asN, P and K) on population dynamics of insect pests (Lu et al., 2007). Since fertilizers may result in higher growth rate and population increase of herbivorous insects through improving nutritional quality of host plants (Edwards et al., 2009). Vermicompost increased levels of phenolic compounds in the leaves of bell pepper and thereby decreased life table parameters of M. persicae (Mardani-Talaee et al., 2016). On the other hand, induced resistance in bell pepper cultured in vermisompost-treated culture (Mardani-Talaee et al., 2016). In case, physiological parameters of treated and non-treated aphids by fertilizers must be determined to better understanding of observed changes. So, the current study was conducted to compare potential changes in physiological processes of M. persicae induced by fertilizers.Chemical fertilizer (zinc sulfate) and vermicompost (30 %) were separately added into cultural soil of C. annum to find their effects on digestion, intermediary metabolism and antioxidant activities of M. persicae under greenhouse conditions. These findings will increase our understanding on beneficial or detrimental effects of fertilizers to better management of M. persicae in greenhouses.

Soil amendment with fertilizers increases level of organic matters and soil biological interactions led to fertility and relative host plant resistance to pest damages (Luong and Heong, 2005). Also, organic fertilizers, e.g., vermicompost, may increase amounts of phenolic compounds in host plants which definitely affect biological performance of insects, the phenomenon has been observed in M. persicae (Mardani-Talaee et al., 2016). Adults of

M. persicae fed on zinc sulfate-treated C. annum showed the highest activities of digestive enzymes while the aphids on control and vermicompost treatments had the lowest enzymatic activities except for chymotrypsin, aminopaptidase and β-glucosidase. These results imply on suitability of C. annum reared on zinc sulfate cultural soil. The suitability may be created due to higher amounts of nutrients or lower levels of plant secondary metabolites which prevent growth and development of insect via repellency or inhibitory mechanisms on digestive enzymes (Terra and Ferreira, 2005; Nation, 2008). The effect of vermicompost to increase amounts of secondary compounds in M. persicae and Leptinotarsa decemlineata (Coleoptera: Chrysomelidae) (Mardani-Talaee et al., 2015, 2016). Mardani-Talaee et al. (2015) reported the higher contents of flavonoids, anthocyanins and phenolic compounds in potatoes cultured in the soils containing 30 % of vermicompost. Similar findings were obtained in C. annum cultured in vermicompost compared to control and zinc sulfate treatments (Mardani-Talaee et al., 2016).Stevenson et al. (1993) found that phenolic compounds were responsible for development retardation of Spodoptera litura (Lepidoptera: Noctuidae) reared on wild ground nut. Haukioja et al. (2002) reported that changes of consumption rate in Epirrita autumnata (Lepidoptera: Geometridae) due to presence of phenolic compounds.Edwards et al. (2009) highlighted the role of phenolic substances to alleviate feeding performance in sap sucking insects.

Insects are depend on several processes involved in intermediary metabolism to gain their required energy for biological activities such as flight, reproduction and etc. Intermediary metabolism relies on activities of transaminases to process amino acids for energetic demands, tissue construction and lipid oxidation to provide energy and metabolic water, besides processing of glucose via glycolysis and krebs cycle (Nation, 2008). ALT and AST are the two important enzymes in transaminase mechanisms of insects that catalyze alanine cycle in proline metabolism and facilitate conversion of aspartate and α-ketoglutarate to oxaloacetate and glutamate, respectively (Nation, 2008). These two enzymes are involved in proline metabolism and providing some components for krebs cycle. Although γ-GT is a transaminase but it transfers γ-glutamyl moiety of glutathione to a receptor for glutamate formation so it is important in γ-glutamyl cycle to synthesize and degrade glutathione and xenobiotic compounds (Tate and Meister, 1985). Amaranthus cruentus suffered more insect pest attack than other Amaranthus used and that Amaranths planted on poultry manure attracted more insect pests than Amaranths planted on other Nutrients. (Ogedegbe and Ezeh, 2015)

Conclusion

The above various thoughts about the management of insect pest shows that , the insect pest can be managed with extensive use of organic manures with combining need based application of inorganic fertilizer also. The organic cultivated plant population also attracts the natural enemies of insect pest for food and shelter .The plant bio product also has some pesticidal property which needs to more commercialize. The plant nutrient have different chemical who affect insect pest metabolic activity. So a combining efforts need to be manage insect pest in sustainable manor for increasing farmer income.

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